



Serial No. 10/018,224
August 11, 2005

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. : 10/018,224 Confirmation No. : 7904
First Named Inventor : Klaus GEISSNER
Filed : April 25, 2002
TC/A.U. : 3742
Examiner : L M FASTOVSKY
Docket No. : 095309.50746US
Customer No. : 23911
Title : Electrically Heatable Glow Plug or Glow Rod for Internal Combustion Engines and Method of Making Same

APPEAL BRIEF

Mail Stop Appeal Brief- Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The following is submitted in accordance with 37 CFR § 41.37 along with the requisite fee of \$500 as set forth in 37 CFR § 41.20(b)(2).

REAL PARTY IN INTEREST

DaimlerChrysler AG of Stuttgart, Germany

RELATED APPEALS AND INTERFERENCES

None

STATUS OF CLAIMS

As filed, the application contained Claims 1-4, now cancelled.

08/12/2005 JADDO1 0000003 10018224

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In lieu of the original claims, new Claims 5-16 have been submitted and are the claims on appeal (Appendix).

STATUS OF AMENDMENTS

No amendment has been filed subsequent to the final rejection dated January 11, 2005.

SUMMARY OF CLAIMED SUBJECT MATTER

Applicants recognized that known electrically heatable glow plugs of the type shown in EP 450 185 B1 ([0001])^{*} are subject to creeping corrosion, i.e. intercrystalline corrosion furthered by crystal growth having a tendency to form large grains and also free surface corrosion [0003]. They discovered that this problem could be overcome by surface hardening at least a portion of the electrically conductive coil [0006]. That subject matter is claimed in independent Claims 5, 10, 13, 14 and 15.

The claimed glow plug is shown in Fig. 1 is reproduced below:

*The bracketed references are to the numbered paragraphs in the Substitute Specification.



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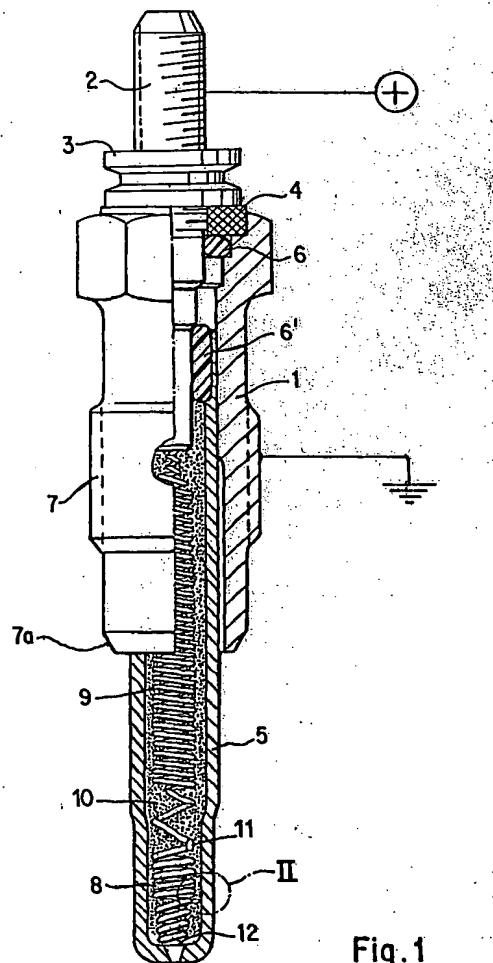


Fig. 1

The above-illustrated glow plug has a glow pipe 5 which is secured in a plug body 1 and is connected thereto in an electrically conductive manner. The casing of the glow pipe generally is made of a nickel-rich iron alloy or of a corrosion-free alloy based on nickel, for example Inconel 601, and is, generally speaking, electrically connected as a ground. This ground connection comes about via the screw-in thread 7 and/or by the cone 7a at the lower end of the plug body 1 [0011].

A heating coil 8 having a welded regulating coil 9, and an electrically insulating, compacted powder filling 10 are arranged in the glow pipe. This powder filling has a number of functions, particularly in the compacted state. First, the powder filling ensures that the heating coil 8 and regulating coil 9 are accommodated and fixed in position within the glow pipe and are held in an electrically insulated manner. The compacted powder allows the heat produced in the heating coil 8 to be passed on as readily as possible to the casing of the glow pipe. In addition, the compressing of the powder eliminates to the greatest possible extent any air pockets, in particular a certain amount of residual oxygen. This requires a particularly intensive compaction of the powder, particularly in the region of the heating coil 8 [0012].

In the heating region the heating and regulating coils 8, 9 are made of a ferritic steel. The regulating coil 9 can be made of pure nickel, which has the function of a regulating resistor and be welded onto the heating coil which is connected to the glow pipe in the tip of the glow pipe via a sealing weld 12 [0013].

Magnesium oxide is generally used as the powder filling 10. In order to compact the powder filling, the filled glow pipe is upset radially from the outside by a concentrically acting striking tool and is thereby reduced in diameter, it also being possible for a conical profile to be achieved. The powder filling is particularly intensively compacted especially in the region of the glowpipe tip by the metal casing there being upset radially in a particularly severe manner [0015].

Because of the intense compaction of the powder filling, the entire coil 8, 9, but in particular the heating coil 8, is severely stressed mechanically. During the radial upsetting, the casing of glow pipe 5 is plastically deformed, as are the associated coils 8, 9. The compacting and compacted powder filling 10 also transmits actions of force from the striking tools acting from the outside isostatically to the turns of the heating and regulating coils 8, 9 and reduces the diameters thereof during this process. The powder filling is, however, not completely homogeneous, but is subject to certain unevenness. Consequently, the forces exerted on the coils via the powder filling differ in size locally in accordance with the dispersion of the powder density [0016].

As noted above, applicants recognize that untreated coils subjected to this compaction have a locally differing plastic upsetting. The differing upsetting for its part causes stochastically pitted surface of the coils 8', as is shown in Fig. 3, which is a cross-section of the detail represented by Fig. 2 constituted the circled dot-dark portion of the lower portion of Fig. 1 using the example of a conventional glow plug configuration and an untreated coil 8' [0016]. (Figs. 2 and 3 are reproduced immediately hereinbelow).

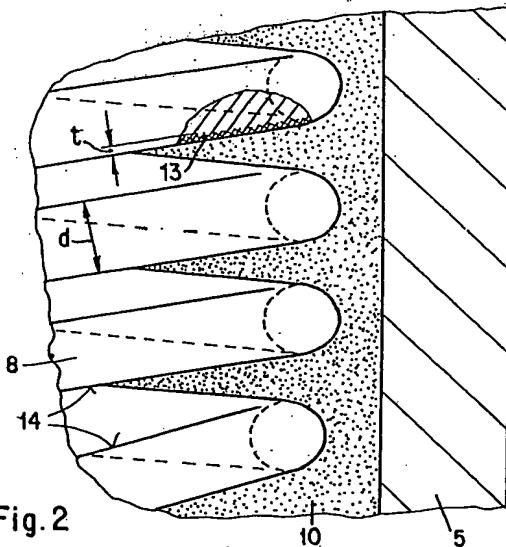


Fig. 2

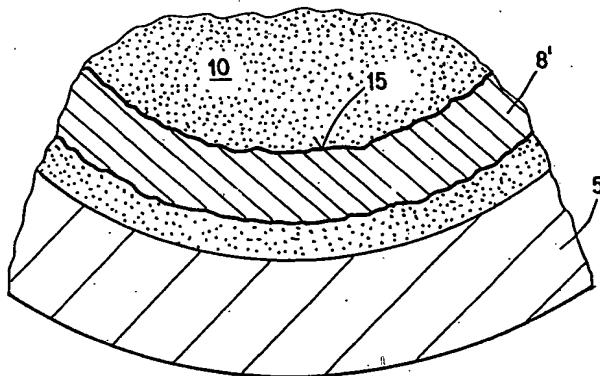


Fig. 3

Even when new, the coil has a pitted surface 15 after compaction of the powder as shown in Fig. 3. The present invention recognized that damage occurs from the outset from the surface pitting because such stochastic pitting results in local cross-sectional constrictions of the coil conductor cross section. This, in turn, leads to a local increase in the electrical resistance and therefore to a locally more severe heating of the coil during operation. As a result, thermal and chemical aging occur more rapidly at this point than at other locations because of the higher temperature level. Such a constriction, which is initially only small and is caused by pitting, of the conductor cross section of the coil can therefore be

a determining factor in the service life, i.e. can be a factor shortening the service life [0017].

The present invention increases the service life of the heating coil 8 which is particularly severely stressed mechanically during compaction and is also particular severely thermally stressed during normal operation. The present invention increases the service life of the heating coil 8 which is particularly at risk, but also coil 9 by surface-hardening. For example, a diffusion treatment such as nitriding, is used and, by forming nitride in the diffusion zone, increases the hardness. The diffusion thereby produces a gradual transition from the hardened edge zone to the soft core. This diffusion zone 13 of the coils 8, 9 expediently has a depth t of approximately 5 to 10 μm as shown in Figure 2 [0018].

The coils are hardened only in an edge layer 13 near to the surface and remain plastically deformable overall. Pronounced pitting of the wire surface during radial compaction of the powder filling is, however, avoided by the hardening of the edge layer. Even after the compaction of the powder filling, the coils have a smooth surface 14 (Fig. 2). As a result, mechanical damage at the outset to the conductor wire is avoided and a longer service-life expectation for the conductor, and therefore for the entire glow plug, is achievable [0019].

GROUNDS OF REJECTED TO BE REVIEWED

The sole issue to be reviewed on appeal is whether the Examiner has set forth a *prima facie* case of obviousness of Claims 5-16 under 35 U.S.C. § 103 based upon the hypothetical combination of Jakobi et al and Carter et al. Applicants submit that the answer is unequivocally no.

ARGUMENT

The final rejection admits that the glow plug disclosed on the Jakobi et al primary reference, which is co-owned by the real party in interest in this case, does not teach surface hardening of the coil. At most, Jakobi et al represents the state of the art prior to the present invention as described in the present invention. Thus, when the final rejection asserts in support of the obviousness conclusion that the Patent and Trademark Office need only take into account knowledge which was within the level of ordinary skill at the time the present invention was made, it must be perforce relying solely upon the Carter et al plug assembly for establishing the level of ordinary skill.

The invention here is not surface hardening *per se*. Rather it is the application of the known surface hardening process, e.g. nitriding, to a specific component which had not been previously surface hardened. The record evidence, i.e. Carter et al, does not establish otherwise.

The Carter et al glow plug assembly, does not use a filling of compacted powder in which the coil is embedded. Thus, although the Jakobi et al and Carter et al patents are only generally both directed to ignition glow plugs, they are of two fundamentally different types. Consequently, the creeping corrosion problem does not occur in the Carter et al device as it would in the products covered by Claims 5-13 made by the method of Claims 14-16 or that of Jakobi et al.

The Carter et al patent describes an oxide hardened catalytic wire 6. It says nothing about whether the wise is surface hardened and does not teach why it is hardened. Thus, even assuming arguments that one of ordinary skill in the art would have been led to use the oxide hardened wire coil of Carter et al in the Jakobi et al glow plug, the resulting combination would not necessarily be a plug having a coil that is surface hardened by nitriding or the like sufficient to withstand mechanical stress during compacting, yet having a gradual transition from the hardened surface to the soft core so as to remain plastically deformable. There is not even a hint of such a teaching in the Carter et al patent.

The combination of Jakobi et al and Carter et al is all the more incomprehensible with respect to method Claims 14-16 inasmuch as the final rejection does not explain where Carter et al teach the step of surface hardening at least a portion of the coil and thereafter embedding the surface hardened coil on a powder felling that is compacted within the glow pipe. Nor does Jakobi et al suggest such a method.

The rejection of dependent Claims 7-9 and 12 and independent Claim 13 as product-by-process claims is unsubstantiated in law or in fact. Certainly with regard to dependent Claims 7-9 and 12 which are unquestionably dependent, directly or indirectly, upon product Claims 5 and 10, respectively, the dependent claims are not product-by-process claims. Rather, the final rejection simply ignores the limitations of those claims which in any event are not directed to process steps but characteristics of structure elements. That is, for example, Claim 7 covers a coil with a diffusion treated, surface hardened characteristic, or the process of producing that characteristic. Likewise, Claim 8 which defines the diffusion zone depth of the coil, not the step of producing the depth; Claim 12 which defines the surface characteristics of the coil as a diffusion treated surface; and Claim 13 again defining the coil as having a surface hardened characteristic. Thus, the limitations of the aforementioned dependent claims cannot be ignored by categorizing them --incorrectly that-- as product-by-process.

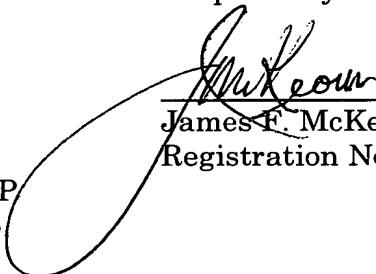
Accordingly, reversal of the final rejections of Claims 5-16 is respectfully requested.

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This Appeal Brief is accompanied by a check in the amount of \$500.00 in payment of the required appeal fee. This amount is believed to be correct, however, the Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, to Deposit Account No. 05-1323, Docket No.: 095309.50746.

Respectfully submitted,

August 11, 2005



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APPENDIX

1-4. (Cancelled)

5. (Previously presented) Electrically heatable glow plug or glow rod for internal combustion engines, having a corrosion-resistant glow pipe which is closed at the end and contains a filling of electrically non-conductive, compacted powder in which an electrically conductive coil is embedded, wherein the electrically conductive coil is surface-hardened.
6. (Previously presented) Glow plug or glow rod according to Claim 5, wherein at least a heating coil is surface-hardened.
7. (Previously presented) Glow plug or glow rod according to Claim 5, wherein the electrically conductive coil is surface-hardened, at least over part of the longitudinal extent, by a diffusion treatment.
8. (Previously presented) Glow plug or glow rod according to Claim 7, wherein a hard diffusion zone of the electrically conductive coil has a depth of approximately 5 to 10 µm.
9. (Previously presented) Glow plug or glow rod according to Claim 7, wherein the diffusion treatment is nitriding.
10. (Previously presented) An electrically heatable heater for internal combustion engines, comprising:
a corrosion-resistant glow pipe which is closed at an end,

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electrically non-conductive, compacted powder filling contained within the glow pipe, and

an electrically conductive coil which is embedded within the filling,
wherein at least a portion of the electrically conductive coil is surface-hardened.

11. (Previously presented) A electrically heatable heater according to Claim 10, wherein the surface-hardened portion is at least a heating coil.

12. (Previously presented) An electrically heatable heater according to Claim 11, wherein the surface hardening is by way of a diffusion treatment.

13. (Previously presented) An electrically conductive coil for a glow plug or glow rod in an internal combustion engine having a corrosion-resistant glow pipe closed at one end and containing a filling of electrically non-conductive, compacted powder, the conductive coil is operatively embedded in said filling and surface-hardened.

14. (Previously presented) A method of making an electrically heatable glow plug or glow rod for an internal combustion engine, comprising:

surface-hardening at least a portion of an electrically conductive coil,
positioning the conductive coil in a corrosion-resistant glow pipe,
embedding the conductive coil in an electrically non-conductive powder filling within the glow pipe,

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compacting said powder filling, and
closing an end of the glow pipe.

15. (Previously presented) A method of making an electrically heatable glow plug or glow rod for an internal combustion engine comprising surface-hardening at least a portion of an electrically conductive coil.

16. (Previously presented) A method according to Claim 15, wherein the conductive coil is operatively embedded in an electrically non-conductive compacted powder filling within a glow pipe.